CHRYSOTHAMNUS NAUSEOSUS SSP. *UINTAHENSIS*: A STABILIZED HYBRID

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ABSTRACT.— *Chrysothamnus nauseosus* ssp. *uintahensis* (Asteraceae) is formally described and illustrated. The new subspecies represents stabilized hybrids that most probably have *C. nauseosus* ssp. *hololeucus* x *C. parryi* ssp. *attenuatus* ancestry. Morphological and anatomical comparisons are made among the putatively related taxa.

While annotating the *Chrysothamnus* collection at Brigham Young University a few years ago, I encountered an unusual specimen from Uintah County (*Welsh & Moore 6759*). It looked intermediate between *C. nauseosus* and *C. parryi*, and I labeled it as "hybrid." Its pollen stainability was determined to be 60.4%. Later I received a collection from Sherel Goodrich that I thought was possibly a new subspecies of *C. nauseosus*. S. Goodrich, E. Neese, K. Thorne, and I observed the new subspecies in the field and made collections. Only after subsequent laboratory studies did I realize that the new subspecies and the Welsh collection were one and the same. *Chrysothamnus nauseosus* ssp. *uintahensis* appears to be a stabilized hybrid; it is technically described and illustrated (Fig. 1), and aspects of its biology are given.

Methods and Materials

Fresh materials of *Anderson 5513* and *5520* were processed for anatomical study as in Anderson (1970). Five heads were measured (as in Anderson 1964) for involucral and floral data. Cytological methods are those of Anderson (1966).

Taxonomy

Chrysothamnus nauseosus **(Pallas) Britt. ssp.** ***uintahensis*** **L. C. Anderson**, ssp. nov. Frutex humilis effusus plerumque 1–2 dm altus, caulibus decumbentibus vel ascendentibus tomentosis albis; folia linearia vel oblanceolata, 1–3 cm longa, 1–3 mm lata, cana vel viridia, in ramis floriferis superioribus plus minusve reducta; cyma paniculata compacta; capitula 11–13 mm longa, 2.2–2.7 mm lata, phyllariis 16–35 acuminatis vel cuspidatis subcarinatis basi margineque pilis sparsis obsitis; disci flosculi 4–5 flavi, tubis corollarum dilatatis plerumque 8–9.2 mm longis dense breveque pubescentibus, lobis 1–1.5 mm longis; lineae stigmaticae styli appendicibus saepissime breviores; achaenia dense pubescentia.

TYPE: Utah, Uintah Co., raw sandy clay of Duchesne River Formation, 2 mi ENE of Lapoint, 19 September 1981, *L. C. Anderson 5513* (Holotype: BRY; Isotypes: FSU, MO, NY, RSA, UC, UTC).

Low, spreading shrub 1–2(5) dm tall, stems white tomentose, decumbent or ascending; leaves grayish white or green, alternate, entire, linear to narrowly oblanceolate, 1–2(3) cm long, 1–2(3) mm wide, falcate, ascending, some weakly crispate, cuspidate, tomentose, more or less reduced on upper flowering branches; inflorescence a tightly congested paniculate cyme; heads (11)11.5–12.5(13) mm long, 2.2–2.7 mm wide, phyllaries (16) 18–32(35), stramineous, ovate to broadly lanceolate, weakly keeled in more or less vertical rows, sparsely pilose-tomentose basally or on margins, glabrous distally, acute to acuminate or cuspidate; disk flowers (4)5, yellow, corollas (7.2)8–9.2(9.7) mm long, tubes abruptly dilated at point of staminal departure (at ca 50% of total corolla length, Fig. 1e), densely short pubescent, lobes (0.9)1.0–1.5(1.8) mm long, lanceolate, erect; style 10.5–13.5 mm long, stigmatic lines usually much shorter than style appendages at 29–35%(52%) of style branch length; achenes

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Fig. 1. *Chrysothamnus nauseosus* ssp. *uintahensis*: a, flowering branch (*Anderson 5513*); b, stem segment of *Anderson 5520* with larger leaves (same scale as a); c, flowering head of *Anderson 5520*, phyllaries acute and vertically aligned; d, flowering head of *Anderson 5513*, phyllaries acuminate, their vertical alignment less pronounced; e, flower with characteristic dilation of corolla tube.

cylindric, 6 mm long, densely villous, pappus 5.7–7.0 mm long; n = 9. Locally established on barren sandy clay or gypsiferous clay in open desert scrub (*Artemisia nova*, *Atriplex*, *Oryzopsis*, and *Stipa*), on Dakota Formation, Duchesne River Formation, or Mowry Shale, 5400–5750 ft, (July)September–October.

ADDITIONAL SPECIMENS EXAMINED.— Utah (all Uintah Co.): type locality, *L. C. Anderson 5516* (FSU, CS, DS, GH, NA, RM, UT), *5517* (BRY, FSU), S. *Goodrich 15263* (ASU, BRY, DS, FSU, MO, UTC), *19669* (BRY), *E. Neese et al. 11014* (BRY, FSU); 3.2 mi E of Lapoint, S. *Goodrich & R. Jepson 15944* (BRY, FSU); 0.4 mi E of Tridell, S. *Goodrich 19267* (BRY, FSU); 8 mi W of Maeser, S. *Goodrich 16427* (BRY, FSU); 4 mi W of Maeser, S. *L. Welsh & G. Moore 6759* (BRY, FSU, NY, UC); Steinaker Lake, *E. D. McArthur & A. C. Blauer 74-16* (SSLP), *74-17* (SSLP), both labeled as "*C. nauseosus* ssp. *salicifolius* x *C. parryi* ssp. *howardii*?"; Red Fleet Reservoir, 10.5 air mi NE of Vernal, *L. C. Anderson 5520* (BRY, FSU, MO, NY, UTC); *5521* (ASU, BRY, CS, COLO, FSU, MO, NA, NY, UT, UTC), *E. Neese & M. Chatterley 9892* (BRY, FSU); 15 mi E of Vernal, *E. Neese 6336* (BRY, FSU).

The new subspecies is striking in its rather barren setting with its yellow heads contrasted against green leaves and white stems. Its involucral bracts approach those of *C. parryi*, but the compact paniculate inflorescences are attributes of *C. nauseosus*. A collection from Cottonwood Creek Canyon in Emery County, *B. Maguire & B. L. Richards 14801* (UTC), may belong here or it may be anomalous; its final disposition has not been determined.

CYTOLOGY

The chromosome number in dividing root tip cells of *Anderson 5513* is 2n = 18. Meiotic material of *Goodrich 19669* was graciously supplied by S. Sanderson and E. D. McArthur. I was able to confirm their unpublished count of n = 9. Good bivalent formation occurs in meiosis. Meiotic regularity has been noted for other suspected hybrids (Anderson 1966, Anderson and Reveal 1966). Micronucleoli were prominent during latter stages of meiosis in some microsporocytes; they have been noted for other taxa in the genus (Anderson 1966, 1983).

Averages for pollen stainability in aniline blue in lacto-phenol are given for several collections in Table 1 in addition to the 60.4% reported for the Welsh collection. Several of the collections had irregular pollen grains such as unstained grains, dwarf and giant grains with stained protoplasts, and grains that were nonaperturate or polyaperturate. The mean pollen fertility for these populations of the Uintah Rabbitbrush is 76.7%, which is lower than that reported for the Ash

TABLE 1. Selected floral measurements for *Chrysothamnus nauseosus* ssp. *uintahensis* and related taxa.

		Involucre		
Collection (or taxon)	Pollen stainability	Bract number	Length mm	Width mm
Anderson 5513	.690	25.2	12.1	2.22
Anderson 5516	.975	26.4	11.7	2.22
Anderson 5520	.959	19.8	11.8	2.40
Anderson 5521	.662	17.6	11.6	2.34
Goodrich 15263	.960	32.4	12.4	2.69
Goodrich 19267	.822	16.6	11.6	2.40
Neese 9892	.461	28.8	12.2	2.76
MEANS				
C. nauseosus ssp. *uintahensis*	.767	23.8	11.9	2.43
C. nauseosus ssp. *hololeucus*		16.6	8.8	2.33
C. parryi ssp. *attenuatus*		14.0	13.4	3.19

Meadow hybrids (Anderson 1973) but higher than that of some interspecific hybrids in the genus (Anderson 1966). A direct correlation of pollen fertility to closeness of parental relationship cannot be made because of the high variance in pollen fertility among suspected hybrids in a given population or set of populations (Table 1 and Anderson 1973).

Floral Morphology and Anatomy

Measurements of selected floral features of the new subspecies are listed in Table 1, and means of the features for the subspecies and possibly related taxa are given. The Uintah Rabbitbrush is fairly uniform for involucral length but extremely variable for involucral bract number. Wide variance in that feature has been noted for a few other taxa (Anderson 1983). Another feature with considerable variability is the relative length of the stigmatic lines on the style branches; the stigmatic line:style branch ratio is usually reasonably constant for *Chrysothamnus* taxa (Anderson 1964). Variability in the Uintah Rabbitbrush may relate to its purported hybrid background.

Flowers have 5–7 (usually 5) vascular bundles in the ovary wall. The extra 1–2 bundles, when present, end blindly at the top of the achene rather than entering the corolla tube. Two style traces are present as is standard for the genus. Additional traces of phloem are directed toward the style base but terminate at the top of the ovary; that condition is found fairly frequently in *C. parryi* (Anderson 1970). Secretory canals are not as frequent in the flowers as they are in most *C. nauseosus* and *C. parryi*. They are fairly well developed in the achene, less so in the corolla, and absent in the style. Trichomes are abundant at two sites on the flower. The twin hairs of the achene average 470 μm long. The biseriate glandular hairs on the corolla tube usually have 12 cells and average 166 μm long. Trichomes are more abundant on the corolla tubes of the Uintah Rabbitbrush than in any other *Chrysothamnus*.

Relationships

Gross morphology justifies placing the new subspecies in *C. nauseosus*, but morphology of the involucre plus certain anatomical features strongly suggest that *C. parryi* is involved with its parentage. The most likely ancestral parents are *C. nauseosus* spp. *hololeucus* and *C. parryi* ssp. *attenuatus*. The Uintah Rabbitbrush has floral morphology that is largely intermediate to those two, i.e., involucral length and width (Table 1), phyllary shape and alignment (Fig. 1), involucral pubescence, corolla lobe length, and stigmatic line–style branch length ratio. The new subspecies is distinctive in its increased phyllary number and reduced corolla length.

Table 1 continued.

Disk flower						
Flower number	Corolla length mm	Corolla lobe length mm	Style length mm	Style branch mm	Stigmatic line: Style branch	Pappus mm
5.0	8.04	1.02	11.2	3.77	.296	6.24
5.0	7.97	0.91	12.8	3.74	.494	6.80
4.6	9.50	1.68	13.0	3.58	.326	6.14
5.0	8.31	1.05	13.3	3.62	.324	7.02
4.8	8.30	1.10	10.6	4.70	.521	6.23
5.0	8.74	1.22	11.0	4.02	.290	6.96
4.6	8.06	1.01	11.1	3.34	.354	5.70
4.9	8.42	1.14	11.9	3.82	.372	6.44
5.0	8.98	0.90	12.8	2.86	.532	6.44
5.3	9.62	1.64	14.4	4.56	.339	9.31

Floral anatomy correlates well with other phylogenetic indicators in *Chrysothamnus* such as karyology, aspects of gross morphology, and environmental preferences. The index of specialization (on a scale of 10), as determined from floral vasculature and secretory canal abundance (Anderson and Fisher 1970), ranges from 7.3 to 7.9 for *C. nauseosus* ssp. *uintahensis*. Indices for *C. nauseosus* ssp. *hololeucus* and *C. parryi* ssp. *attenuatus* are 5.4–5.6 and 5.2–5.6, respectively. Interestingly, the suggested level of specialization for the new subspecies (definitely derived) is higher than that of the parental groups even though one might expect its floral anatomy to be intermediate to that of the parents.

Uintah County is the northeastern boundary of the ranges for both suspected parental taxa. Actually, all interspecific hybridizations in *Chrysothamnus* occur at the edge of the range of at least one of the parental species even though the two parental taxa may be largely sympatric. Apparently some breakdown of internal genetic barriers accompanies the general stressing that must occur in geographically peripheral populations (Anderson 1966).

The Uintah Rabbitbrush is well established in a specific ecological setting. Abundance and distinctive morphology qualify these stabilized hybrids for taxonomic recognition. Since no general conclusions about the most appropriate way to treat such populations taxonomically exist (Raven 1980), I choose to recognize them as a subspecies of *C. nauseosus* because the majority of their expressed characteristics show that affinity.

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